XI

Compliments of Mr. South - with the Author

AN ACCOUNT

OF

TWO NEWLY DISCOVERED

MUSCLES

FOR COMPRESSING

THE DORSAL VEIN OF THE PENIS,

IN MAN AND OTHER ANIMALS;

AND ALSO

OF A SIMILAR PROVISION

FOR COMPRESSING THE VEINS OF THE CHAMELION'S TONGUE.

from the Dublin Hospital Reports

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ETC. ETC.

There exists a striking resemblance in the general construction of the penis among the different tribes of the mammalia. In all of them we find corpora cavernosa giving form and bulk to the organ, a corpus spongiosum enveloping the canal of the urethra, together with blood-vessels and muscles, all so arranged as to establish a complete uniformity of design in the construction of the organ throughout the whole of this extensive class of animals.

The structure of the cavernous bodies is now well ascertained. By a variety of processes, such as injection, corrosive macerations, &c., it has been rendered evident, that the whole texture is vascular; that with the exception of the fibrous laminæ which give form and strength to the organ, the entire is composed of vessels, chiefly veins, anastomosing and coiling among each other in a most intricate manner. In man, and some other animals, this part of the penis consists of two cylindrical bodies placed parallel; in others these cylinders are so connected as to appear single; and in all they are fixed by two roots or crura to the pelvic bones. Even in the Cetacea, where the only traces of a pelvis are two slender bones suspended loosely in the flesh, the crura penis have some connection with these rudimental productions. The existence of a bony style in the centre of the cavernous bodies of some of the carnivora is the most remarkable variety to be noticed regarding their structure.

The corpus spongiosum urethræ is likewise composed of innumerable blood-vessels; it is situated underneath the cavernous bodies, envelops the canal of the urethra for a great part of the extent, is generally enlarged into a bulb at the root of the penis, and swells out at its extremity to form the glans. There is much variety in

different animals in the relative magnitude of the cavernous and spongy bodies. In some of the carnivora, as in the dog for example, the glans, when the penis has been injected, constitutes more than three-fourths of the bulk of the whole organ.

The arteries of the penis are derived from the internal iliac : they in general spring from a single trunk on each side, termed pudic, and afterwards make their way through the organ in several directions. Two branches usually enter the bulb, and supply the corpus spongiosum ; two enter the corpora cavernosa by their crura, and two, the arteriæ dorsales, after passing under the arch of the pubis, apply themselves on the dorsum of the penis, and then run forwards parallel to each other, as far as the root of the glans, in which chiefly they are distributed. These several branches not only supply respectively those parts of the organ to which they are distributed, but also hold communications with each other more or less freely in different stages of their course. The most extensive anastomosis takes place between the arteriæ dorsales supplying the glans, and the vessels of the bulb and corpus spongiosum, but both these have communications through the fibrous investment of the corpora cavernosa with the arteries which enter these bodies by their crura.

The veins of the penis agree in number and situation with their arteries, and like them hold numerous anastomoses among themselves. Those which accompany the bulbous and cavernous arteries bear the ordinary proportion to these vessels; and are so inconsiderable as to have been almost passed over in the description of the blood-vessels of the organ. Those which correspond to the arteriæ dorsales are the principal veins for the return of the blood; their magnitude and uniformity of position have been long a matter of general notoriety. Their branches emanate from all parts of the penis: those derived from the corpus spongiosum, wind round the sides of the organ, and coalesce on its dorsum, with those which spring from the glans and cavernous bodies. By the assemblage of all, two trunks are first formed; these run parallel until they arrive near the pubis, where they unite and form a large vessel, which passes singly under the centre of the arch, and immediately after, spreads out into a plexus, covering with its branches the sides of the bladder and prostate gland, and terminating ultimately in the iliac veins. (See Plates IV. V. VI. *g.g.*) While under the arch, the dorsal vein occupies the centre of the upper surface of the penis; and the arteries and nerves lying on each side are generally placed at a short distance, or kept apart from it by a fibrous partition.

In man, and all the animals which I have dissected, the situation of the great dorsal vein is precisely as above described. In the horse, the ram, and some others, in whom the veins of the penis are of great size, perhaps too large to be collected into one vessel, we find them passing the arch of the pubis in several trunks, which however lie closely congregated together. Some varieties also occur in different animals as to the place at which the branches unite to form the single vein, the point at which its re-division is afterwards effected, or the distance of the arteries and nerves from it, but in all, a striking uniformity in this general arrangement will be found to exist.

It is most probable that the veins are the chief, perhaps the only seat, of that sanguineous accumulation which occurs during turgescence of the penis, and that the arteries contribute little more to this state than by carrying the blood into the organ. The extensible and elastic coats of the veins possess a property of accommodation to a variable quantity of fluid which the unyielding and rigid tunics of the arteries will not allow of. A ligature which gives rise to instantaneous turgescence in the vena dorsalis beyond the point of its application, produces no evident alteration in the size of the artery leading into the organ when tied

around that vessel. And in experiments on the penis of living animals, I have seen the greatest variety in the degree of plenitude of the veins, but have never been able to discover any difference in the fulness of the arteries, in its most extreme states of turgescence or collapse.

The veins which emanate from the crura and bulb, bear the ordinary proportion in size to their arteries; but the dorsal veins are in a vast degree larger than the arteries which they accompany. The former appear to be adapted for the ordinary purposes of nutrition and circulation; the latter, it is probable, are more connected with a peculiar condition of the organ, erection.

The musculi erectores penis, acceleratores urinæ, and transversales perinæi, are found in most of the mammalia, but vary considerably in development in different individuals; and in several of them other muscles are added, not present in man. There is much want of decision in our knowledge respecting their uses. The functions which they are supposed to perform, as implied by the names attached to them, cannot, on the ordinary principles of the action of muscles, result from their contraction.

The erectores penis, (Pl. VI. *l.*) cannot by

any effort, so press on all the veins of the penis as to produce congestion in them. The remarks of Haller on this head are very judicious. He says, "venas magnas penis musculi erectores omnino comprimere nequeunt, id ut facerent, oportet ortos esse ab osse pubis aut certe supra penem."—(Vol. ii. pp. 483, 560, 564.) The only veins which, during the contraction of the erectores, could at all suffer compression, are those which emerge from the crura, the most inconsiderable of any; and even they are much removed from muscular influence by the strong fibrous investment of these bodies. We cannot, however, but suppose that they have some participation in the act, though their unfavourable arrangement mechanically disables them from being the sole agents in its production.

Our notions concerning the uses of the acceleratores urinæ, (Pl. VI. *m.*) are equally unsettled; but as regards their influence in producing turgescence, their position is not such as to give them much greater power than the erectores penis, though their more direct application to the bulb, together with the greater delicacy of the investment of that part of the organ, disposes them more favourably for exercising pressure on its veins.

The transversales perinæi, from their remote

situation with respect to all the blood-vessels of the penis, can exert no influence whatever over the circulation through the organ.

It must be evident then, from a consideration of the arrangement of all the muscles, that their combined powers are inadequate to produce that remarkable stagnation of blood which occurs during turgescence in the organ, whilst the widest, and most direct outlet for the fluid, that by the great dorsal veins, remains unobstructed. This insufficiency of cause to effect, has been long known and felt by physiologists; and Haller, who devotes a whole chapter to explain and refute the opposing theories of different writers, impressed with the fact that the ordinary muscles are insufficient to cause the change of condition observable in erections, comes to a conclusion not more satisfactory than the opinion of his predecessors, that the whole phenomenon depends on a more abundant supply of blood, independent altogether of any mechanical agency. He says, "Ego equidem a sanguinis majori copiâ adfluente quam redit, persuadeor totum phenomenon pendere." This theory, like all the others, unsupported by facts, and improbable in its nature, may be looked upon rather as an evasion than as a final settlement of the question, affording room and encouragement for farther investigations on the subject.

In giving rise to that congestion which manifestly occurs in erections, there are most probably two phenomena in operation, the one a peculiar elevation of nervous energy, which attracts through the arteries of the part a sudden and abundant flow of blood ; the other, a mechanical process, by which the blood is detained during the act in the veins of the organ.

The proportionate share which each of these causes exerts can not be easily determined, and perhaps, in different instances, according to the duration or intensity of the congestion, the proportion will be found to vary.

There are many instances met with, among animal bodies, of considerable erectile action, in which a mechanical provision to arrest the flow of venous blood cannot be demonstrated ; such are the turgescence of the nipple, caused by the contact of the infant's lips ; the enlargement of the wattles of the cock at certain periods ; the swelling out under irritation of those tumors known by the name of aneurisms by anastomosis, &c. In these, the turgescence being only transient and inconsiderable, it may consist in little more than an increase of the nervous sensibility, attended with a copious influx of blood, independant of any active mechanical influence.

But though such cases as this occur, in which our evidences of a mechanical application are doubtful, there are yet others, where the organ is large, and where a particular effect is required from its turgescence, in which I hope to demonstrate that such a provision is adopted to detain the venous blood, and give effect and duration to the process.

The establishment of such a fact would be important, and perhaps might justify the inference, that in every case of the kind, though our senses cannot discover it, the accumulation of fluid may, in some way, be directed by mechanical agency.

My attention was first directed to this subject by a communication made to me by the late ingenious Mr. Shekleton. In dissecting the penis of a dog he discovered two muscles connected with the venæ dorsales, and admirably adapted for making such compression on these vessels as to obstruct the current of blood in their canal. But the melancholy event which deprived the world of the fruits of his genius, also stopped his further prosecution of this subject. I afterwards found, on inquiring as to the originality of the observation, that the great Cuvier, whose extended researches have left little room for farther discoveries in anatomical

science, makes notice of the existenee of such museles as these. His allusion to them is however only eursory, and his opinion regarding their funetions undeeided. The result of my own observations respeeting their existenee in different animals, and the extent of their influenee in produeing ereetions of the penis, together with the discovery of a similar apparatus conneeted with the lingual veins of the chameleon, I shall now proeeed to detail.

The museles are situated between the arch of the pubis and the penis. I propose to name them *compressores venæ dorsalis penis*. I have found them readily in every animal which I examined. In the dog, wolf, jaekall, bear, badger, cat, raeeoon, coati-mondi, marmot, aguti, horse, seal, &c. &e., and encouraged by the eertainty of their existence in these animals, together with the general resemblanee which the muscles, blood-vessels, and erectile tissue in them bears to the same struetures in the human body, I persevered in my search for them in man, by a variety of dissections, until at length I discovered them on the 15th of July, 1830, and satisfaetorily demonstrated them to many of the pupils and several professors in Dublin, among the latter of whom, I have the privilege of enumerating Drs. Cusack, Jacob, and Graves, whose expressions of satisfaction as

to the presence of the muscles, and their favourable arrangement for exerting pressure on the vena dorsalis, afford abundant testimony of their existence.

In a good sized *dog*, (Pl. IV. fig. 1. *k. k.*) each of the muscles is about three quarters of an inch long, and at its origin one-third of an inch broad: it arises from the posterior part of the ramus of the pubis, about one inch below the symphisis: it thence inclines inwards, and a little upwards, and growing narrow, ends in a tendon which joins that of the opposite side in the mesian line, precisely opposite the common trunk of the dorsal veins. The muscular fibres are red and distinct, the tendon silvery and strong, and divided transversely by a slit, through which the vein takes its course. The slit in the tendon will be readily discovered, when its edges are cleared of a thin fascia, which by being prolonged from them on either side, renders the opening indistinct. At the place where the muscles can exert pressure on the vein the arteries and nerves are removed to a short distance, and separated from them by a fibrous partition.

In the *monkey*, simia viridis, L. (Pl. IV. fig. 2. *k. k.*) the compressores venæ are easily discovered. Their situation is between the pubis

and membranous part of the urethra, where the vein, as in most other animals, is single. The muscular fibres are strongly marked. The tendon formed by their junction is flat and broad, and divided where it crosses the vein into two portions, separated by a small interval, through which the vein is pereeptible. The tendon is loosely attaehed to the vessel, it glides easily over it, but sends no slip underneath, as in the dog.

In the *bear*, urs. arct. L. (Pl. V. fig. 1. *k. k.*) the attachment of the muscles, and the relation of their common tendon to the solitary vena dorsalis, is the same as in the dog, with the exception, that the whole of the tendon is plaeed on the upper surfaee of the vessel.

In the *badger*, urs. meles, L. (Pl. V. fig. 2. *k. k.*) the muscles are somewhat long and narrow; and their tendon is divided for the passage of the vein. In this instance the arteries and nerves are plaeed at some distanee from the vein, and perhaps are saved thereby from any pressure of the museles during their contraction.

In the *cat*, notwithstanding the diminutive size of the penis, the musculi compressores venæ may be found without much difficulty.

In the *coati mondi*, viverra nasua L., they run to the sides of the vein, and are inserted into a fibrous sheath, by which it is enveloped.

In the *aguti*, mus aguti L. (Pl. V. fig. 3. *k. k.*) the muscles arise from the inner edges of the crura penis, and thence form an arch like a sphincter round the vessels. The muscular fibres in this animal meet over the vein without the intervention of any tendinous structure.

In the *horse*, in which the venæ dorsales pass in separate trunks under the pubis, the tendons of the musculi compressores are subdivided into several portions, which run among the vessels, some over, some under, and some in the midst of them; so that, by the union of those of opposite sides, an arrangement is established which gives to the muscles a very considerable power in compressing and closing up the veins. In the other animals, above enumerated, the attachments, form, and position of the muscles, are, with trifling modifications, like those which have been just described, and in all they are easily discovered when the penis has been dissected with care from the pubis.

In *man*, the compressores venæ dorsalis, are

less distinct than in most of the mammalia. They arise from the rami of the pubis, (Pl. VI. *k.*) above the origin of the erectores penis and crura, and ascending in a direction forwards are inserted above the vena dorsalis by joining with each other in the mesian line. They form a thin stratum of muscular and tendinous fibres, about one inch long and three quarters of an inch broad, and may perhaps be looked upon as portions of the erectores penis, which, instead of being inserted into the sides and lower part of the corpora cavernosa, mount over those bodies, to exert their compressing influence on the vena dorsalis. They enclose between them and the penis the vein, arteries, and nerves of this region. Their anterior fibres are distinguished from those of the erectores, by the fibrous attachment of the crura to the pubis; their posterior margins are kept distinct from the front part of the levatores ani, known under the name of Wilson'sMuscles, by the pudic artery, which divides them in its course towards the dorsum of the penis.

The best procedure to display these muscles is the following. Detach the bladder and levator ani with the hand from one side of the pelvis; then divide with a saw the pubis and ischium about one inch from the symphisis, and break off the bones at the sacro-iliac articula-

tion : next dissect away carefully the remaining portion of the pubis from the symphisis, periosteum, and crura penis, and then the compressores venæ, bearing still their natural relations to the crura and other muscles, may be exposed with very little difficulty.

The insertion of the muscles being in a great measure outside the pelvis, they may also be demonstrated without the section of the bones, by cutting on them in front of the pubis, and looking carefully for their tendon at the side of the vena dorsalis: from the tendon the knife may be carried downwards and backwards in the course of the fibres, and nearly the whole of the muscle can be thereby exposed.

It must, however, be remembered, that it will be needless to search for them in a thin emaciated individual, where the other muscles of the perinæum are so pale and soft that even they can scarcely be distinguished. The subject should be robust, and the muscles red, in order to demonstrate them.

In regard to the arrangement of the veins in relation to these muscles, it is precisely as in the other animals spoken of; it is single at the place where the muscles are connected with it, and immediately after passing them is di-

vided into numerous branches, which run backwards on both sides between the bladder and levator ani, to empty into the iliac veins. (Pl. VI. *g. g.*)

The disposition of the plexus, formed by the veins of the penis in relation to the bladder and levatores ani, is a circumstance which merits more consideration than has been given to it. The contraction of the levator ani causing it to press against the sides of the bladder, may contribute to the congestion of the penis; or, on the other hand, the accumulation of urine in that viscus, even in cases where the muscles of the spine are paralyzed, may, perhaps, be the cause of the erections which so frequently attend on such injuries. There is one thing certain, that the painful priapism attendant on retention of urine from over-distention is instantly relieved by the use of the catheter; and a similar condition of the organ in a case of hemiplegia from injury, I have seen removed by the same instrument. On this point I am not prepared to offer any more certain information. I merely throw out the hint, that those to whom such cases may occur, may attend to the connexion between the two inconveniences, priapism and retention of urine, with a view towards determining how far the one may be consequent upon the other.

The use of the musculi compressores venæ is self-evident, and cannot be mistaken; the effect of their contraction will be to close the vein, and mechanically obstruct the current of blood. A simple experiment will prove to demonstration, that such will be the necessary result of their contraction. Let the muscles be stretched in the natural direction of their fibres, and any fluid forced into the vein will not find a passage through the vessel beyond the spot where it is compressed by their tendon: a very gentle pull of the muscles will be sufficient to produce this effect.

In cases where the vein runs through the tendon the pressure will be most efficacious; but even in those in which the tendon is arched over the vein, its descent from the contraction of the muscles will sufficiently compress the delicate tunics of the vessel to produce the required effect. The solitary and naked condition of the vein at this spot adapts it admirably for the application of such an agent; and the attachments and form of the muscles makes them not less ingeniously fitted for producing compression of the vessel. The elasticity of the arteries, and in some cases their distance, or even their separation from the veins by a fibrous partition, guards them against the pressure of the mus-

cles, and secures to the organ an entrance for the arterial blood.

That the musculi compressores venæ should be proportionably less developed, and less readily detected in man than in other animals, is a circumstance which might be urged against the use which I have assigned to them. But it would appear to me that an observation of the difference which exists in the relative size of the vena dorsalis, as compared with the other veins of the organ in these animals, will explain away the objection : for in those individuals in which the greater part of the penis is composed of corpus spongiosum and glans, as is the case in most of the carnivora, and where consequently the greater share of blood is returned by the vena dorsalis, I have observed that the muscles are largest, and their tendon most defined and closely connected with the vein. The observation extended to the human subject, only marks the correspondence in the arrangement, and confirms the view I have taken of the use of the muscles, without lessening the plausibility of my theory.

Perhaps, too, their greater development may be connected with the more prolonged state of turgescence, so remarkable in certain of these animals.

But, though the existence of these muscles be thus demonstrated, and the mechanical effect of their contraction on the current of blood through the great veins of the penis be admitted, yet the extent of their influence in the production of erections in that organ still remains to be determined. Is their contraction the sole cause of the phenomenon? or does it perform only a secondary office, that of giving permanency and intensity to the turgescence? With a view to determining this question, the following experiments were instituted.

November the 16th, I made an incision about two inches in length along the left side of the penis of a dog, and to the inner side of the spermatic cord and testicle. The cellular membrane at the root of the penis being divided, a ligature was tied around each of the venæ dorsales, a short way before their junction under the pubis, special care being taken to avoid including either the arteries or nerves in the noose. A few sutures were then made in the skin, and the animal placed aside in quietude. The veins, when first exposed, appeared shrunk and nearly empty, but suddenly became enlarged and full when pressed upon near the root of the penis. Their state of plenitude varied with the application or removal of the pressure, though the obstruction did not at the moment appear

to influence the general size of the organ. During the operation the penis remained flaccid, but shortly after the application of both ligatures, and even before the wound was all stitched, an increase of size in the glans and bulb became manifest. During the day, notwithstanding that the animal appeared languid and cold, an increasing turgescence was perceptible in the penis, which was rapidly augmented on the slightest irritation.

For the two succeeding days the symptoms continued nearly the same. There was a constant thirst, with little disposition for food. There was but inconsiderable local inflammation, and nevertheless the penis became turgid so rapidly on the animal's being approached, that it was sometimes difficult to determine whether or not that condition was permanent, or only brought on by the excitement. On comparing him with a healthy dog, the effects of the operation were made manifest: in the latter the penis, when examined, was always found collapsed, and the rapidity of turgescence, excited by irritation, was neither so instantaneous nor so permanent as in the animal whose venæ dorsales were obstructed.

On the fourth day the symptoms were much aggravated. The animal suffered so much from

the intensity of the turgescence that he became infuriated, and several times was thrown into violent convulsions.

On the 5th day the turgescence continued nearly as uninterrupted and intense as the day before, but the convulsions did not return, and the animal was so lean and exhausted that he could scarcely stand without tottering.

From this period he gradually began to resume his wonted state, and in about three weeks from the time of the operation, the penis had nearly lost that morbid susceptibility to turgescence, which in so marked a degree followed the application of the ligatures on the veins, without however being deprived of the power of taking on this state on exposure to the natural causes which induce it.

It may be necessary to state, in order to account for this return of the capability of erection after the obstruction of the venæ dorsales, and, as might be supposed, after the neutralization of the uses of their compressor muscles, that on dissecting the animal some months after, I found that the vein was fully open where the tendon was connected with it, and received, as before, the blood of the glans and corpus spongiosum, by some collateral vessels which had become

enlarged for its transmission. Injection thrown into the dorsal vein, leaving the glans, found its way by these branches into the trunk, behind where the ligature had produced obliteration. The muscles, of course, under these circumstances, possessed the same control over the circulation in the vein, as previously to the temporary obstruction in that vessel.

This experiment I have repeated several times, and always with the same results, viz. frequent, easily excited, and long continued priapism, attended with sickness, shiverings, and convulsions. In one case paralysis of the hind legs, and death, followed the same train of symptoms, but in all the others a complete recovery was obtained.

Experiment 2d. I operated on another dog in the same manner, and exposed both the dorsal veins and arteries. The veins were left untouched, and the arteries secured by ligatures as near as possible to the symphysis pubis. The obstruction to the circulation in the artery was unattended by any change in the size of the vessel, such as had been so conspicuously produced in the vein when the current of blood through it was interrupted.

The animal evinced little uneasiness after

the operation, compared with the sufferings in the former case : he had no shiverings, and took food as usual ; during the entire day the penis remained flaccid. I examined it frequently, and never found it either turgid or capable of being excited to turgescence.

On the succeeding day the animal was equally free from sickness or suffering ; and the excitability of the penis was less than even before the arteries were tied. On one occasion, only, did the least tendency to erection manifest itself under artificial irritation.

On the days following considerable inflammation of the wound, ending in abscess, occurred ; but, withal, the animal suffered little, and rapidly recovered without the occurrence of any such untoward symptoms as were consequent upon the obstruction to the venæ dorsales.

The first of these experiments is conclusive. It demonstrates that obstruction to the current of blood in the dorsal veins of the penis, gives rise to a condition of the organ more susceptible of erection, and disposed to remain for a much longer time in that state, than when the vessels are uninfluenced by such obstruction. It would appear, however, from the experiment, that blocking up the veins is not the primum

mobile, the sole cause of the turgescence, as this state was not excited immediately by the operation; such obstruction would rather seem to heighten and prolong the act, when once kindled by an increase of the nervous sensibility, as was shown by the readiness of the organ after the operation to become turgid under artificial excitement, and the permanency of that state, even during a fit of shivering, fever, and convulsions.

The second experiment, though perhaps a negative one, is not without its value, as it not only shows, that diminishing the influx of blood to the penis lessens its disposition and power to become turgid, just as obstructing the efflux increases such a disposition; but it also meets any objection which might be made to experiments on the ground of the irritation produced by them, as in both cases the injury was the same, with exception of the vessels on which the ligatures were applied.

As to the analogy between the natural operation of the musculi compressores on the veins of the penis, and that of the ligatures, which in the experiments caused an intense and long continued turgescence of the organ, our evidence of it can be only presumptive, for no experiment could well be devised which would es-

tablish it, owing to the concealed situation of the muscles. Nor will I, by asserting the analogy, prejudice the judgment which every one will form for himself on the subject. I only put forward the fact of the existence of these muscles; the peculiar arrangement of the veins in relation to them, and their uniformity of construction in all the animals I have examined, together with the experiments demonstrating the effect of obstruction of the veins in keeping up the turgescence, and the desideratum of such a mechanism among physiologists; I put forward all these as facts which cannot be controverted, and I await their issue, as examined and reasoned on by others, before I shall say, that the whole exhibits as beautiful and striking an instance of the wisdom of the Creator, in the application of mechanical principles to the production of a vital effect, as the whole range of physiology exhibits. The muscles act as flood-gates on the veins, the flow of blood through them is obstructed, and the reservoirs are thereby all filled, and kept full until the required effect is produced; whilst outlets for the fluids are provided by the smaller veins of the crura and bulb, to secure against a bursting of the vessels from over-distention.

The tongue of the chameleon is an organ possessing most extraordinary powers of elongation

and retraction, which are exerted in darting against and drawing into its mouth the objects it feeds on. Its structure and mechanism I have already made the subject of an Essay, which may be found in the Transactions of the Royal Irish Academy for 1828, or in the Edinb. Phil. Journal for April, 1829. Its alliance in structure to the erectile tissues I have established on many facts, and the application of the properties of this tissue to the prehension of insects I have shown to be most efficacious.

The *prehensile* extremity of the tongue is attached to the long style of the os hyoides, (Pl. V. fig. 4. *a*.) through the medium of a second portion, which I have named *erectile*.

The *prehensile* part is round and fleshy ; it is hollowed at the end into a cup, which is smeared with a viscid mucus, and provided with retractor muscles, for entangling and grasping the insects. A pair of long muscles, the hyo-glossi, are supplied for the purpose of retracting this part of the organ, when laden and returning with his prey ; and a central tube surrounded by an annular muscle, accommodates and secures it on the style of the os-hyoides when the organ is at rest in the mouth.

The *erectile* portion is the seat of all those

remarkable changes in length which the organ undergoes in the performance of its functions. When the prehensile extremity rests in the mouth, fitted by its tube and muscle on the slippery style, the erectile portion, in the form of a fine membrane, is folded up in small compass, and thrown into plaits on the root of that bone. In darting out the tongue to seize insects, the erectile portion springs from its collapsed condition, and becomes swollen, elongated, and rigid, pushing before it the prehensile extremity, and striking it against the object in view.

The resemblance of its structure to that of the penis is very striking. Its arteries branch out immediately, and are distributed in fine ramifications all through its tissue. Its veins, which are two in number, take a more determined course. They arise from all parts of the organ, run along the centre of its lower surface, pass close by the hyoid bone and between its cornua, just as the vena dorsales penis runs near to the arch of the pubis, and ultimately, after coursing along the neck, empty into reservoirs at the side of the heart, which, as to function, may bear some resemblance to the plexus formed by the veins of the penis previous to their termination in the iliac veins.

So far the analogy holds good; and I am of

opinion that muscles, similar to the compressores venæ dorsalis penis, exist in an equally perfect state in connexion with the venæ linguales of the chameleon, to complete the resemblance in the organs. I have added a sketch of those muscles, which, from their connexion with the veins, appear to me adapted for exerting on them the necessary compression. (Pl. V. fig. 4. *k. k.*) They are those which I had previously named internal cerato-maxillary. I copy their description from the Essay above quoted. "The internal cerato-maxillary is long and slender. It arises from the anterior part of the side of the lower jaw, and passing thence backwards, on the upper surface of the style and muscles, ends in a tendon, which, after uniting with its fellow of the other side, about two lines before the articulation of the cornu with the body of the os-hyoides, becomes broad, and is inserted into the roots of the posterior cornua." I shall here add, what I have, since this description was written, ascertained to be a fact, that the veins run through openings in this tendon, (Pl. V. fig. 4. *g. g.*) as they are passing between the cornua of the os-hyoides, and that the operation of stretching the muscles will interrupt a current of mercury flowing along their canal, just as the experiment of pulling the sub-pubic muscles by their extremities, arrests the passage of any fluid impelled through the vena dorsalis penis.

The internal cerato-maxillary muscles are amongst the number of those which protrude the style from the mouth, a movement which always precedes the evolution of the tongue. They may also during this action constrict the lingual veins by their tendon, and thus perform the double office of protruding the style, which is the preparatory step, and of operating as compressores venarum, in giving rise to their congestion of blood, which is so conspicuous during the elongation of the organ.

The general resemblance in the construction of these muscles to that of the compressores venæ dorsalis, together with the similarity of the effect produced by stretching them on the current of fluid through the veins which perforate their tendons, affords much reason for considering them as designed for the same uses; and the existence of such a mechanism in both cases may, perhaps, justify the inference, that a mechanical obstruction to the egress of venous blood is necessary to the completion of erection, wherever intensity or duration of the act is an object.

Note.—Professor Barkow of Breslau has lately discovered in the eye of birds, that the blood destined to supply the pecten or marsupium, arrives at it through the medium of a

rete mirabile, and that the latter is compressed by the tendon of the pyramidalis muscle, during its action in drawing the membrana nictitans over the eye-ball. This compression of the arteries carrying blood to the pecten, renders it less turgid at the moment the nictitating membrane covers the eye. We have therefore, in this instance, a piece of mechanism employed to diminish the *afflux* of blood to an organ, precisely similar to that discovered by Mr. Houston, to prevent its reflux.

PLATE IV.—Fig. 1.

Representation of the penis musculi compressores, &c, in a Dog,—natural size.

d. d. The prostate gland.

e. The penis.

g. The vena dorsalis. It consists of two branches, on the dorsum of the penis, which unite opposite the arch of the pubis, to favour the application of the compressor muscle, and instantly afterwards spread abroad into a plexus.

h. h. The arteriæ dorsales.

i. i. The nervi dorsales. The arteries and nerves lie at some distance from the vein, and are separated from it by a fibrous structure, which on one side has been cut away.

k. k. The musculi compressores venæ. Their tendon presents an opening in the centre, through which the vein takes its course.

PLATE IV.—Fig. 2.

The superior surface of the penis; musculi compressores venæ, &c., in the Monkey. (Simia virid. L.)

a. The bladder.

b. b. The vesiculæ seminales.

c. c. The vasa deferentia.

d. The prostate gland.

e. The penis.

f. f. The cut surfaces of the crura penis.

g. g. The vena dorsalis penis.

h. h. The arteriæ dorsales.
i. i. The nervi dorsales.
k. k. The musculi compressores venæ. Their tendon is divided into two portions, both of which rest on the upper surface of the vein.

PLATE V.—Fig. 1.

Representation of the penis; musculi compressores venæ, &c., in a young Bear, (Urs. Arct. L.) about eight months old. Figure of the natural size.

a. The bladder.
d. The prostate gland.
e. The penis; the prepuce slit open.
f. f. The crura penis.
g. g. The vena dorsalis.
h. h. The arteriæ dorsales.
i. i. The nervi dorsales.
k. k. The musculi compressores venæ. The tendon undivided and defined.

Fig. 2.—Representation of the compressor venæ, &c., in the Badger. (Urs. Meles. L.)

e. The penis; part removed.
g. The vena dorsalis.
h. h. The arteriæ dorsales.
i. i. The nervi dorsales.
k. k. The musculi compressores. Their tendon perforated by the vein, at some distance from which lie the arteries and nerves.

PLATE V.—Fig. 3.

Dissection of penis, bladder, musculi compressores, &c., in the Aguti. (Mus. Aguti, L.)

a. The bladder.
b. b. b. The vesiculæ seminales, vesiculæ accessoriæ, and glandulæ Cowperi.
c. c. The vasa deferentia.
d. The prostate gland.
e. The penis.
f. f. The crura penis.
g. g. The vena dorsalis.
h. h. The arteriæ dorsales.
i. i. The nervi dorsales.
k. The musculi compressores arising from the inner sides of the crura, and passing as a sphincter around the vessels.
l. The musculi retractores penis, with their long single tendon running under the penis.
m. The prepuce reflected and excised.
n. The bulb of the urethra.

PLATE V.—Fig. 4.

Lingual veins and compressor muscles of Chameleon.

a. The style of the os-hyoides.
b. b. The anterior cornua.
c. c. The posterior cornua.
g. g. The lingual veins passing through openings in the tendon of the compressor muscles.
k. k. The compressores venarum, or, as named in my Essay on the Chameleon, "internal cerato maxillary."

PLATE VI.

A full sized view of the organs and muscles in the male pelvis, shown by the removal of the left os innominatum.

a. The bladder.

b. The vesiculæ seminales—resting on the rectum.

c. The vas deferens.

d. d. The rectum.

f. The cut extremity of the crus penis.

g. g. The vena dorsalis; double where on the penis behind the glans; single under the pubis, and multiplied into many branches on the side of the bladder, where it is covered by the levator ani.

h. h. The pudic artery ending in the arteria dorsalis.

i. The nervus dorsalis.

k. The musculus compressor venæ dorsalis of the left side.

l. The erector penis.

m. The accelerator urinæ.

n. The levator ani.

PLATE IV

PLATE V